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PLANT AND PROCESS VENTILATION

by

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Still another factor of importance is the rate of contamination of the atmosphere. Although data are usually lacking on this rate, it nevertheless has a bearing on the problem equal in importance to the value of the maximum allowable concentration. This point is effectively illustrated in the following problem.

Problem. A new process, which is to be installed in a plant, consists essentially of a rectangular tank 8 ft long by 3 ft wide, containing a solution which generates fumes that are described as extremely toxic to humans. The threshold limit atmospheric concentration is given as 0.001 milligram per cubic meter, equal to 0.00003 milligrams per cubic foot. (This is 100 times as toxic as lead, at 0.1 milligram per cubic meter.) It is known that the process generates the dangerous fume at a maximum rate of 3 milligrams per 100 sq ft of liquid area per hour, or 0.72 mgm per hr from the tank in question.

The tank is to be exhausted by slots along each long side. What is a suitable *minimum* safe rate of exhaust in these circumstances.

Solution. Conventional exhaust ventilation rates for tanks (treated in a later chapter) would call for 100 to 200 cfm per sq ft of tank area. In the absence of data, one might expect a ventilation specification of, say, 4800 cfm. However, the data permit one to calculate the air flow rate required to *dilute* the contaminant to a safe level. The escape rate is 0.72 mgm per hr. To dilute this flow to .00003 mgm per cu ft requires only $.72/(.00003 \times 60) = 400$ cfm. This would be regarded as an insignificant source in the average industrial building. Even though extremely toxic as indicated by the maximum allowable concentration, the quantity evaporating is so minute as to be insignificant in most circumstances. In any case one can conclude that an exhaust at some level *below* 400 cfm would be entirely adequate.

Appearance of Various Dust Concentrations

The dust and fume concentrations given in the tables of threshold limit values can be roughly described in terms of sight perception. Some dusts may be present in potentially harmful concentration though not visible in ordinary interior illumination, and vice versa. For example, quartz dust or lead oxide dust can be present in concentration well above the allowable limit yet not be apparent visually. Harmful concentration of manganese oxide dust on the other hand, would nearly always be apparent.

Table 1-8 provides a rough scale of dust concentration values in terms of the sense of sight. These figures are based on the author's impressions

and should not be regarded in any sense as other than an approximate description. It is clear by comparing this scale of values with threshold concentrations of free silica dust (5 million particles per cubic foot) that hazardous concentrations are apparent visually only under the most favorable conditions of illumination. On the other hand, the figure most generally accepted as defining the upper limits of decent working conditions for miscellaneous non-metallic mineral dusts, 50 million particles per cubic foot, will be visually apparent in nearly all common conditions of illumination.

Concentrations of the toxic heavy metals like lead, with maximum permissible concentrations of 0.1 to 0.2 milligram per cubic meter, are seldom visually apparent until very toxic concentrations are attained.

TABLE 1-8

Sight-Perception Dust Scale

(Visible Dust Concentrations in General Air)

Lighting	Perspective	
	Short Distances (less than 10 to 15 ft)	Long Distances (50 to 200 ft)
	Concentration, Million Particles per cu ft	
Beam of sunlight, background relatively dark	less than 2 (no distance effect)	
Bright sunlight but no beam effect	10–20	2–5
Bright daylight "north" illumination (i.e., interior but no direct sun)	10–20	5–10
Low intensity daylight	20–40	10–20
Dim artificial light (night)	100–200	75–100

Notes:

(a) Mica dust concentrations well below 1–2 million are readily visible in poor light and create an impression of greater dustiness than fact.

(b) Dusts composed of abnormally large amounts of coarse particles, or flocs, appear to be more concentrated than actually (applies to very dusty, violent operations).

(c) In considering *dusts of heavy metals* (e.g., lead oxide, manganese oxide) where results of measurement are expressed in terms of weight concentration, employ the figures above, changing the units to milligrams per 10 cubic meters of air. Thus the first item would apply to lead dust where concentration is "less than 2 milligrams per 10 cubic meters."

(d) Degree of illumination and light contrasts affect visibility greatly, therefore the values listed are highly approximate.